National Transportation Safety Board

School Bus Occupant Protection

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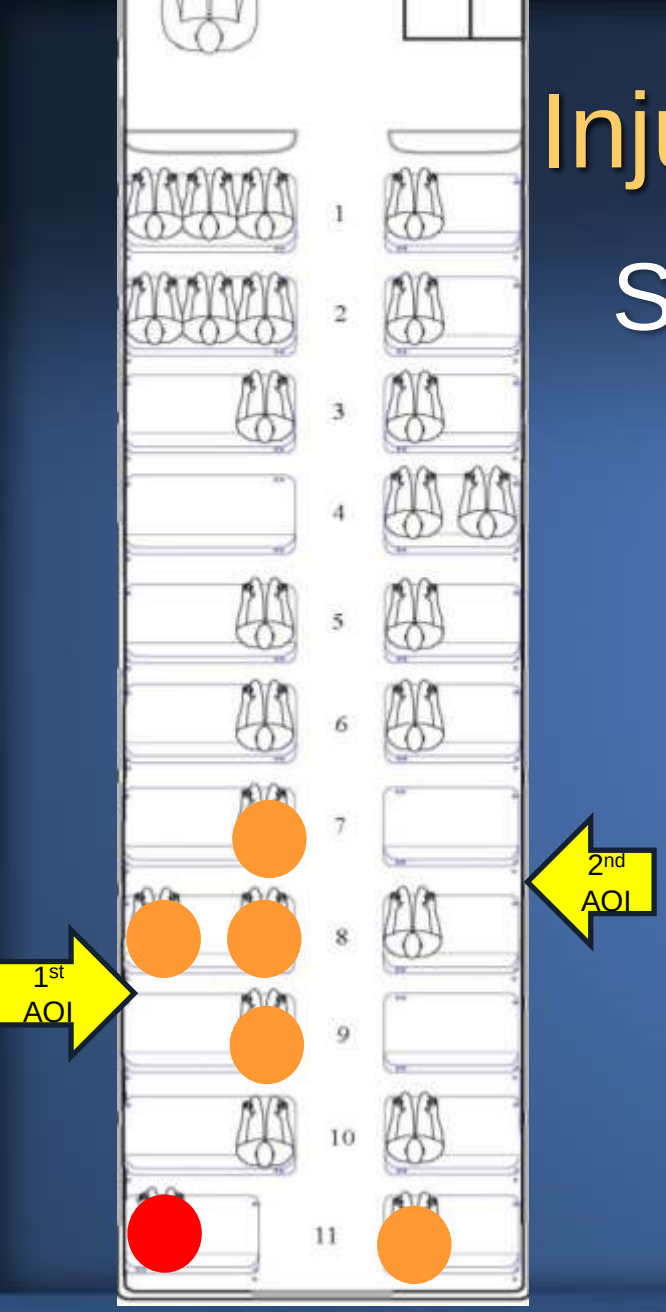
Overview

- Benefits of school bus lap belts
- Occupant protection of interior surfaces
- Integrity of entire seating system
- Benefits of lap/shoulder belts
- Training on use and proper wearing of belts

Injury Information

- School bus occupants
  - 25 passengers
    - 1 fatality
    - 5 serious injuries
    - 10 minor injuries
    - 9 uninjured
  - Driver: minor injuries



Injury Information

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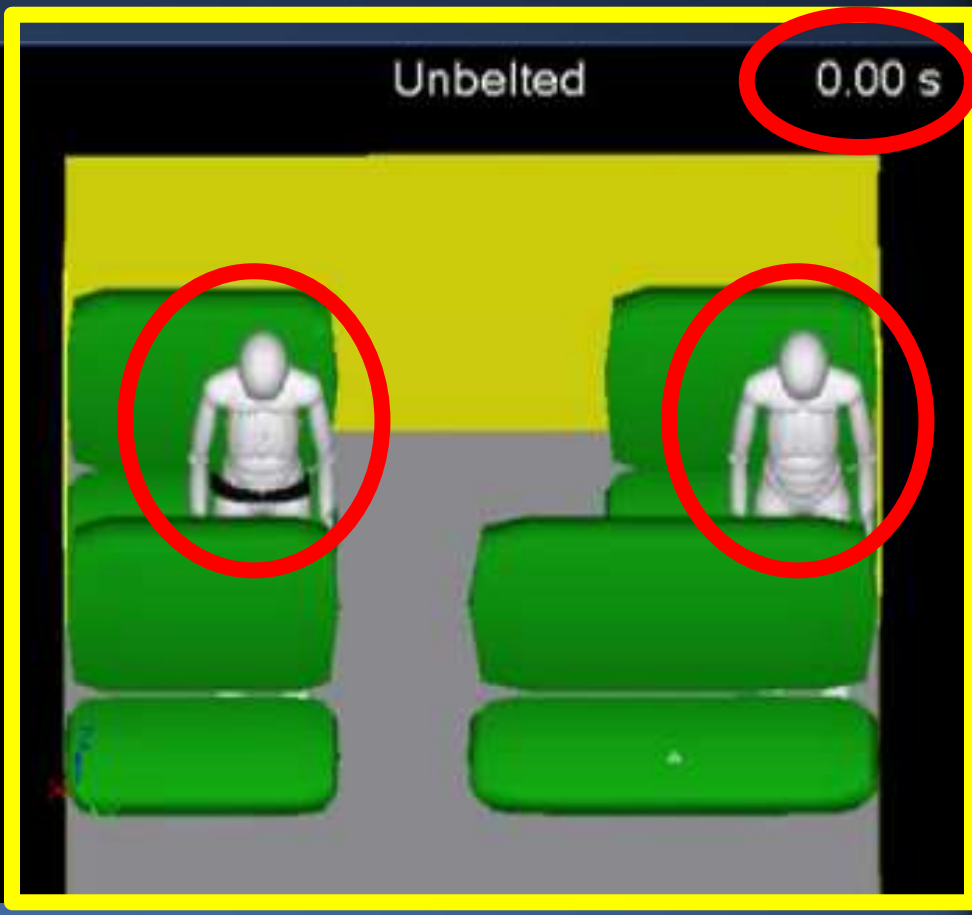
School Bus Lap Belts

- New Jersey requires passenger seat belts on school buses
- Lap belts:
  - Some worn properly
  - Many worn improperly or not at all

Chesterfield: Occupant Kinematic Simulations



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Chesterfield: Occupant Kinematic Simulations

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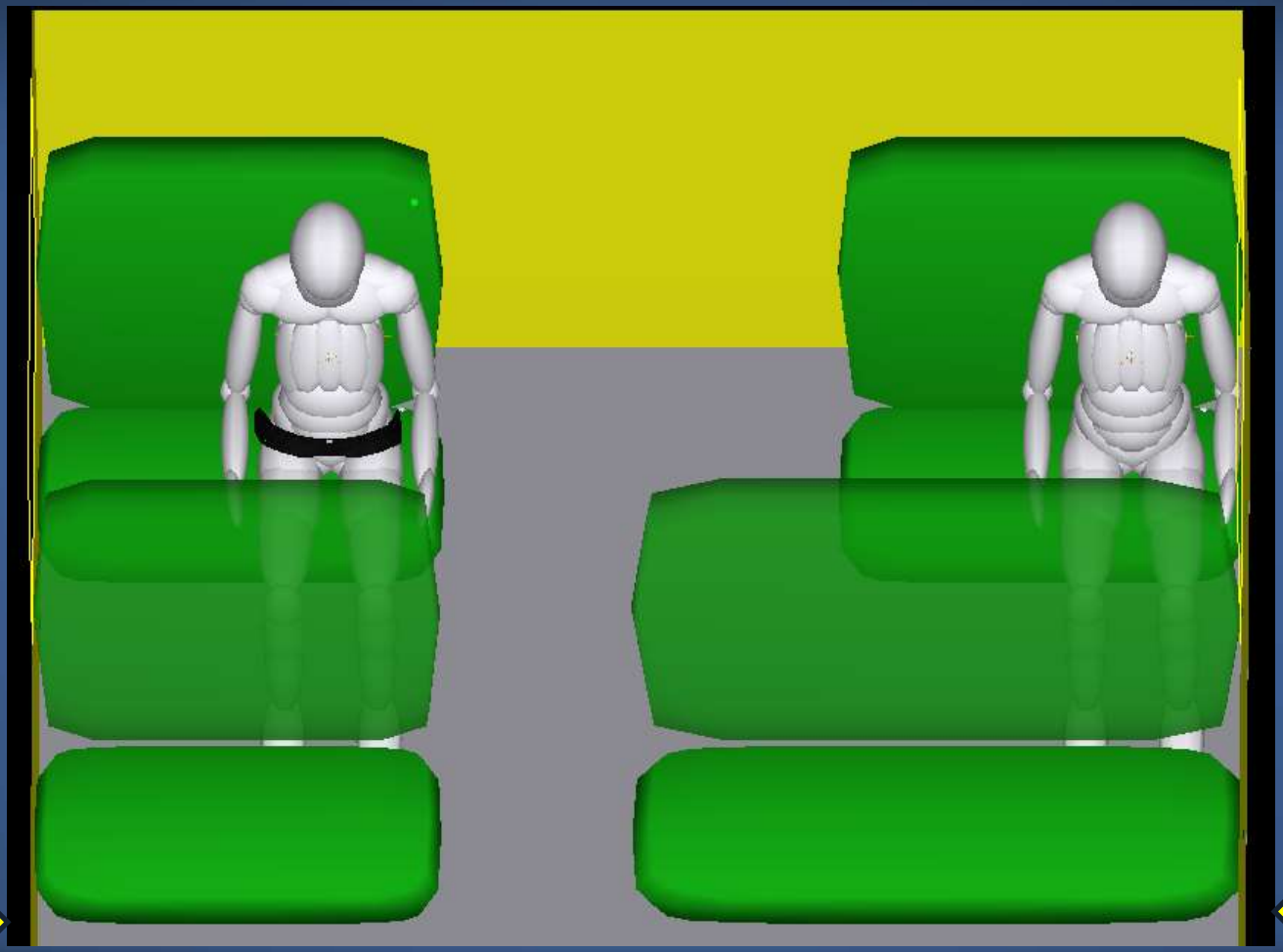

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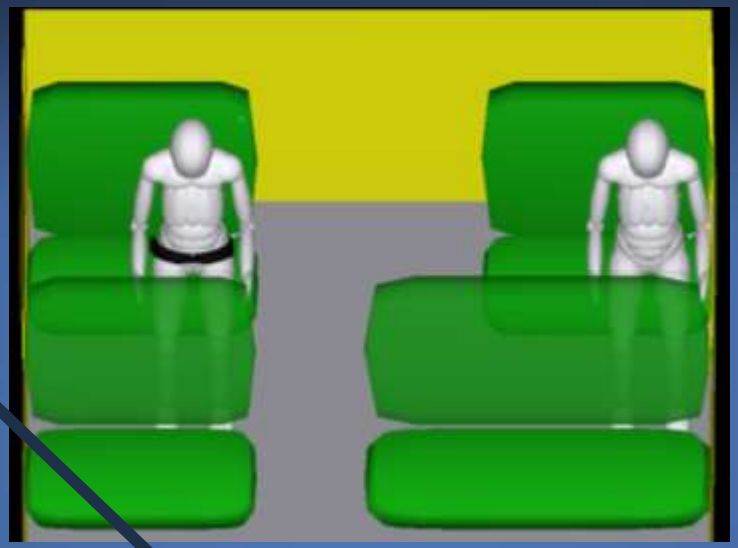
Occupant Kinematics Simulation
Lap Belt Simulation

School Bus and Roll-Off Truck Collision at Intersection

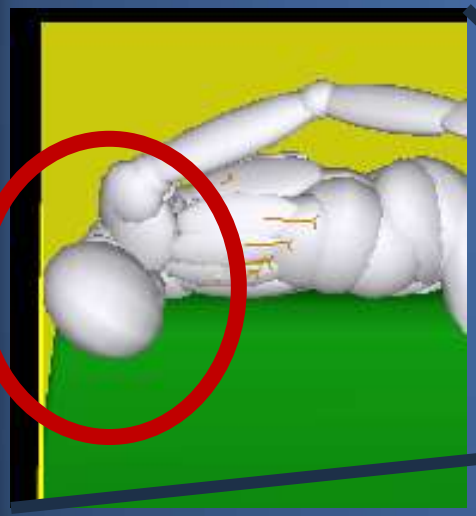
Near Chesterfield, New Jersey
February 16, 2012

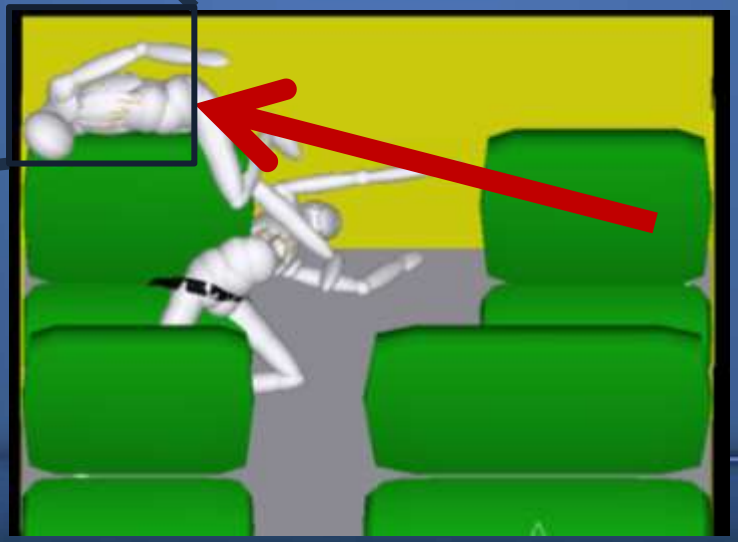
HWY12MH007

Chesterfield: Unbelted Occupant Motion



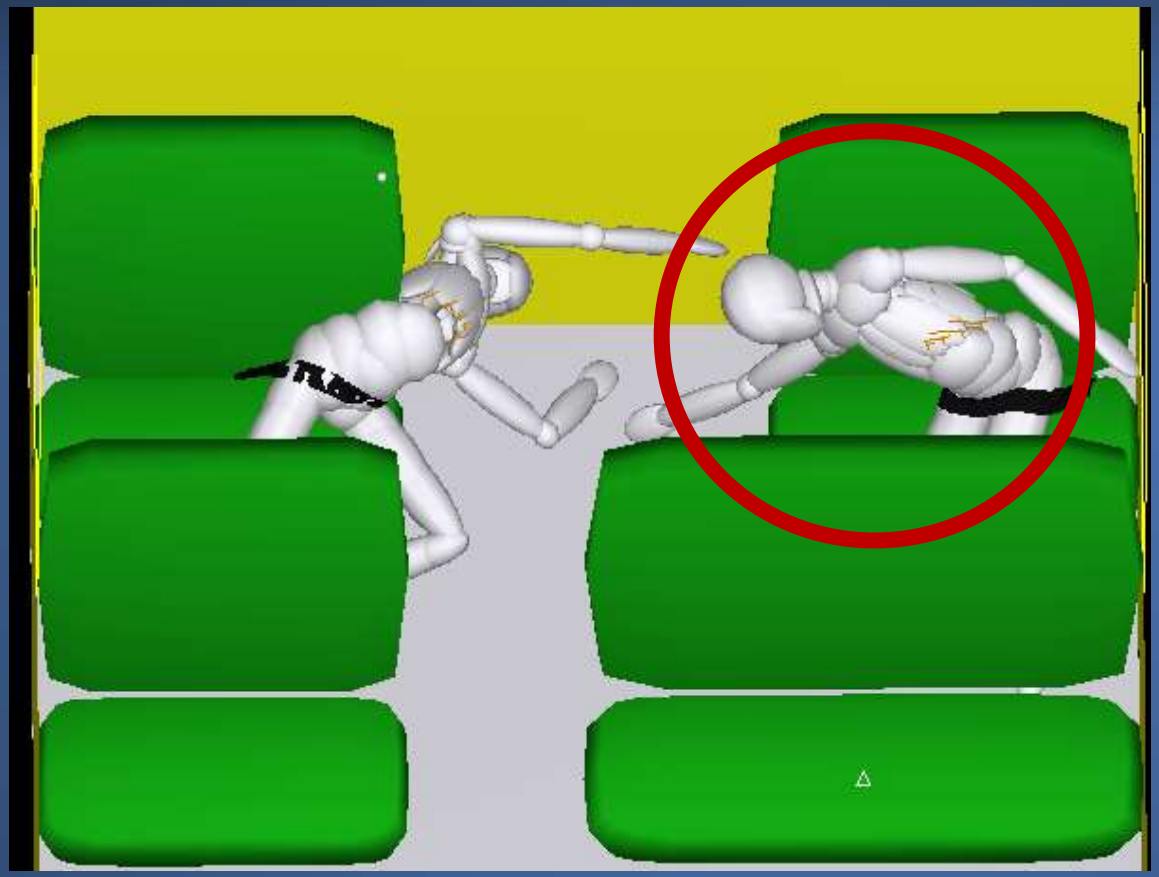
Time = 0.0 second





Time = 1.4 seconds

Chesterfield: Lap Belted Occupant Motion



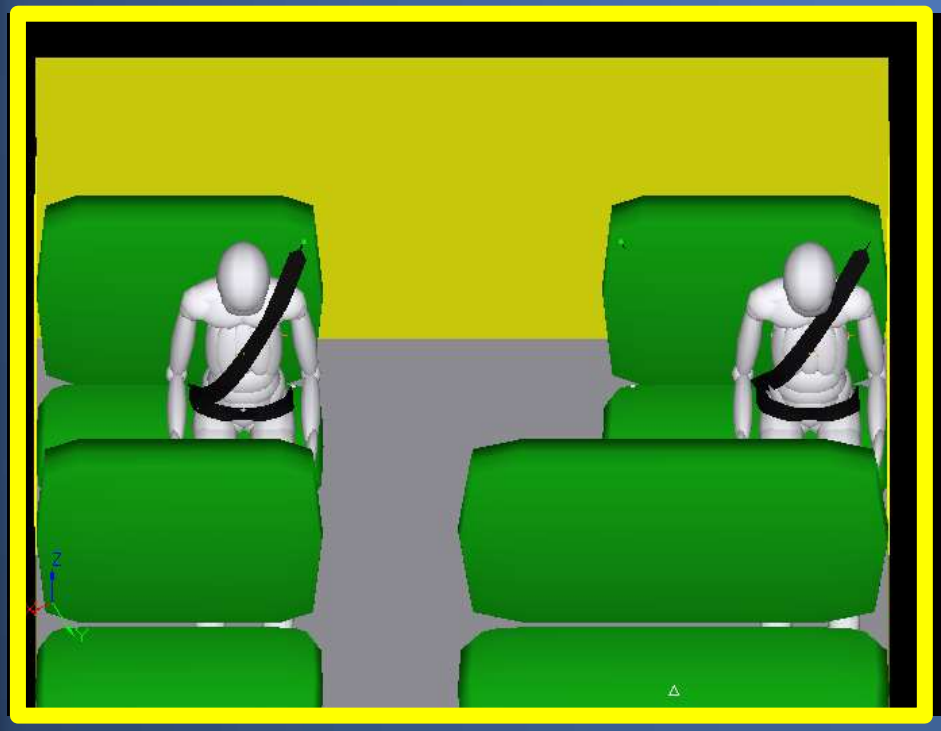
Time = 1.4 seconds

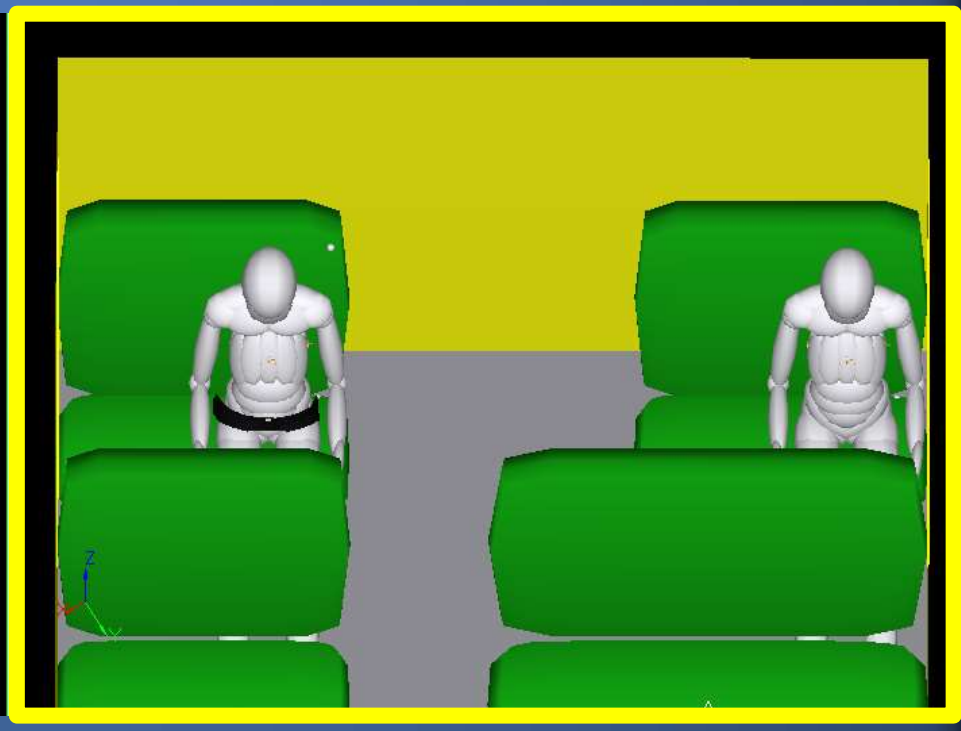
Energy-Absorbing Interior Components

- Lap belts do not prevent injury from upper body flailing
- Previous recommendation to protect interior surfaces
- School buses with compartmentalization alone or with lap belts at risk

Flailing Injuries

- Chesterfield lap/shoulder belted simulation





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Occupant Kinematics Simulation
Lap/Shoulder Belt Simulation

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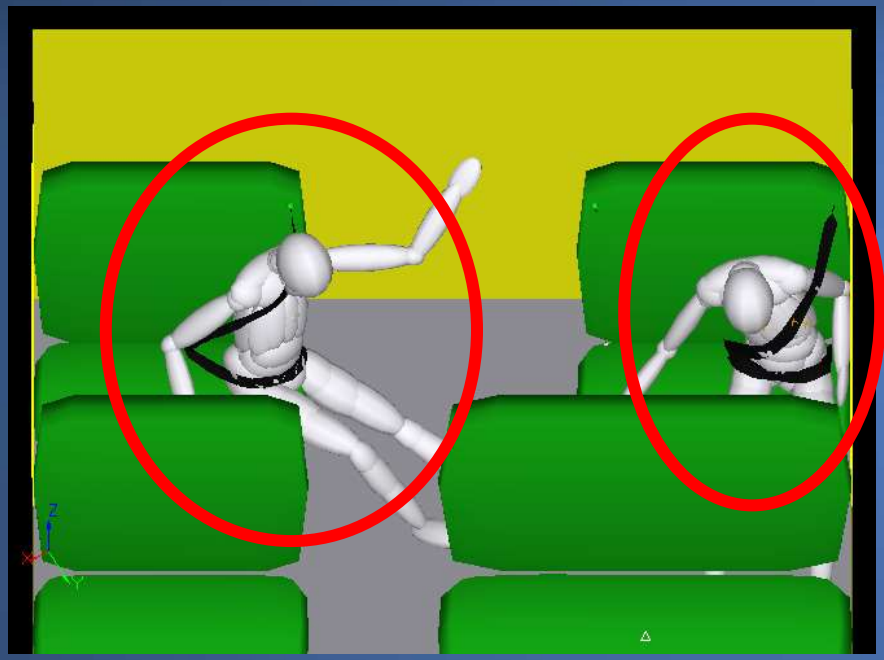
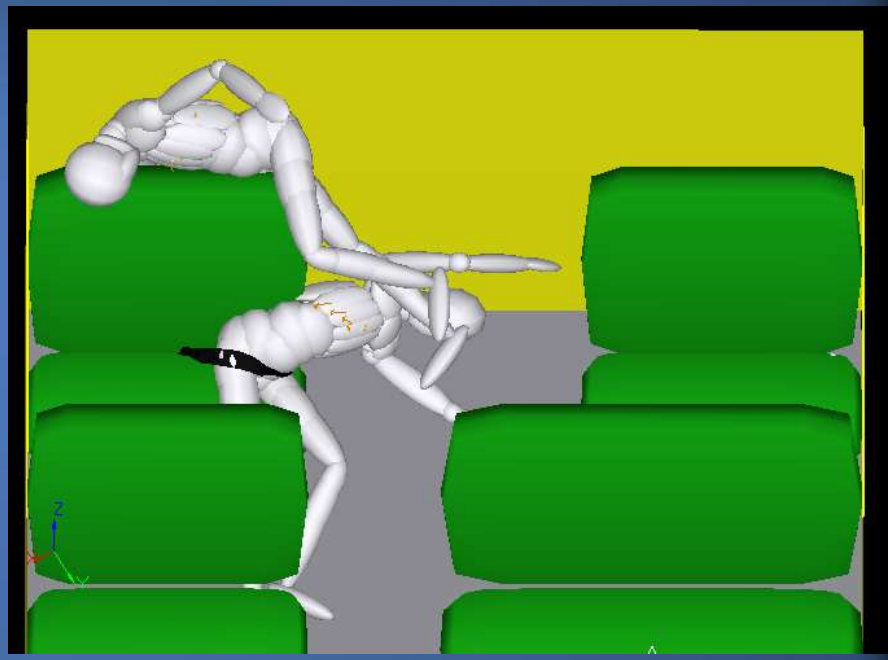
Benefits of Passenger Lap/Shoulder Belts





Port St. Lucie, Florida

NTSB

Port St. Lucie On-Board Video and Audio System

Four active cameras recorded:

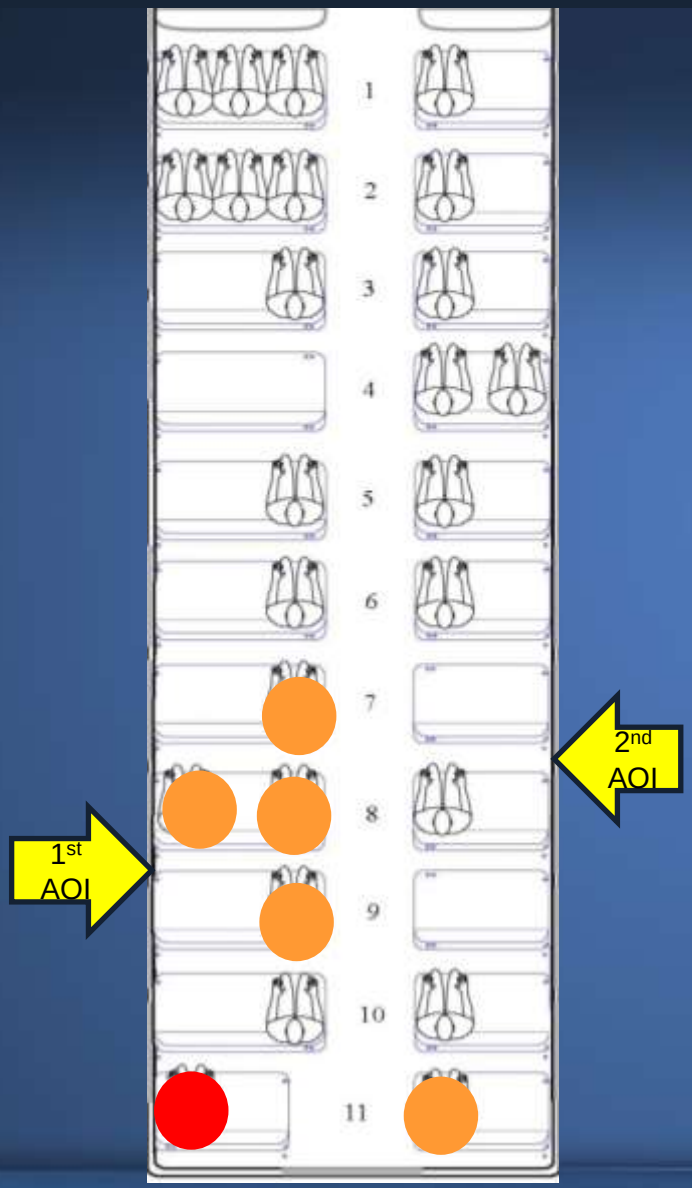
- Student loading
- Entire bus ride
- Impact
- Occupant kinematics and motion to final rest
- 15 minutes postcrash

Technical Collaboration

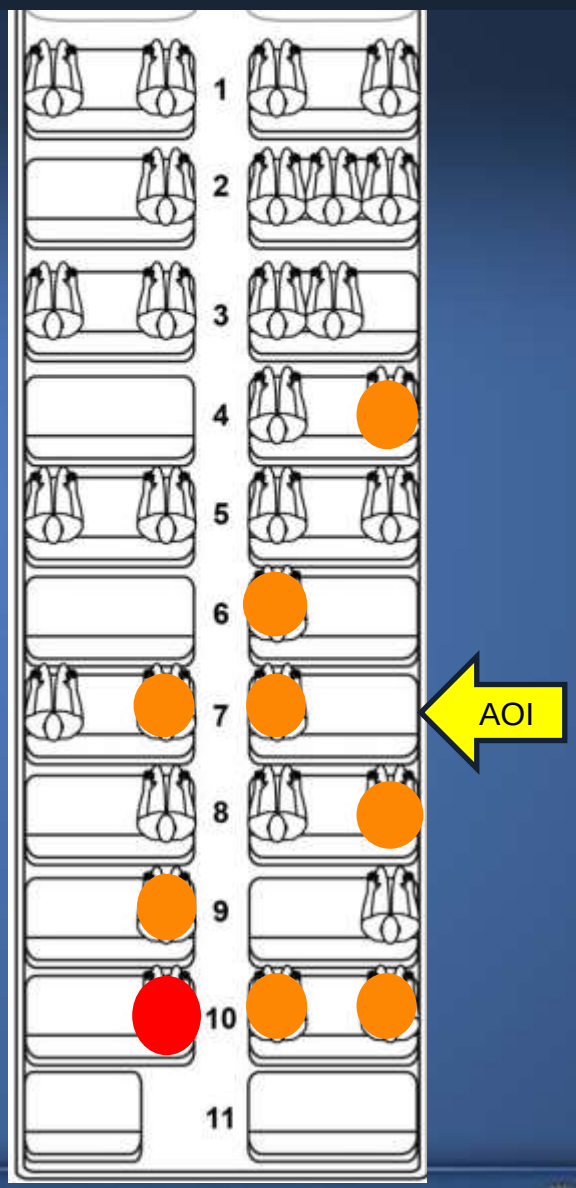
Technical experts

- Children's Hospital of Philadelphia
  - Kristy Arbogast, Ph.D.
  - Mark Zonfrillo, MD, MSCE
- University of Virginia
  - Richard Kent, Ph.D.
- Vital data for future research

Chesterfield



Port St. Lucie



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Port St. Lucie Fatal Passenger

- Not visible from any camera during collision sequence
- Seated aft of intrusion on opposite side
- Properly lap belted
- Highest accelerations
- Greatest potential for upper body flail
- Loss of seat system integrity

Seat Pan (Cushion) Attachment

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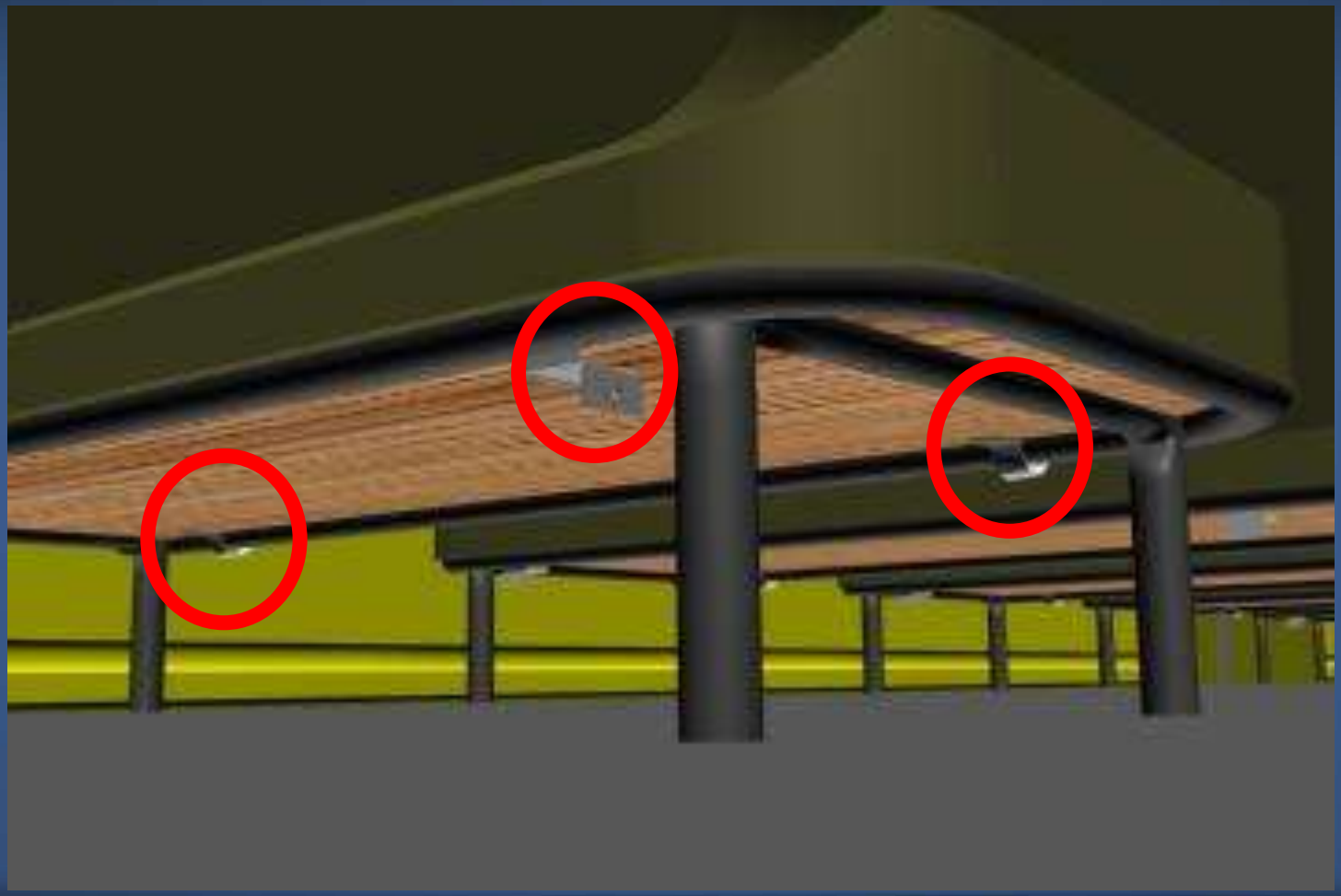

Loss of Seat System Integrity

Proper Belt Use

- Passengers benefit from properly adjusted lap belts
- Educate students, parents, and school districts about:
  - Using available restraints
  - Adjusting belts properly
- Guidelines to assist in training on importance of proper belt use

Summary

- Wear available seat belts properly
- Provide sidewall and side structure occupant protection
- Ensure integrity of complete seating system, including seat cushions

Summary (cont'd)

- School bus lap belts are beneficial
- Shoulder belts reduce upper body flailing and provide greater protection
- Additional training on importance of proper seat belt use

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